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NGMN Radio Access Terminal Requirements

next generation mobile networks

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Abstract

This requirements draft has been produced by the Next Generation Mobile Network Project 8 – "Terminal Aspects." It contains Radio Access Terminal Requirements submitted for adoption by NGMN members and Sponsors (vendors), as well as SDOs and related industry in general.

Besides aligning the main NGMN requirements to Terminal, i.e. services classes enabling, multi-mode operation, transmission rates, mobility, latency, authentication, security, roaming, etc., this draft covers the following areas: radio access and technology, terminal complexity, software platform, spectrum usage, user equipment classes, and Interworking making possible intra/inter system handovers.

The requirements take into account the consultative iterations with leading chipset suppliers and Terminal manufactures, as well as the progress made in the standard bodies such as 3GPP.

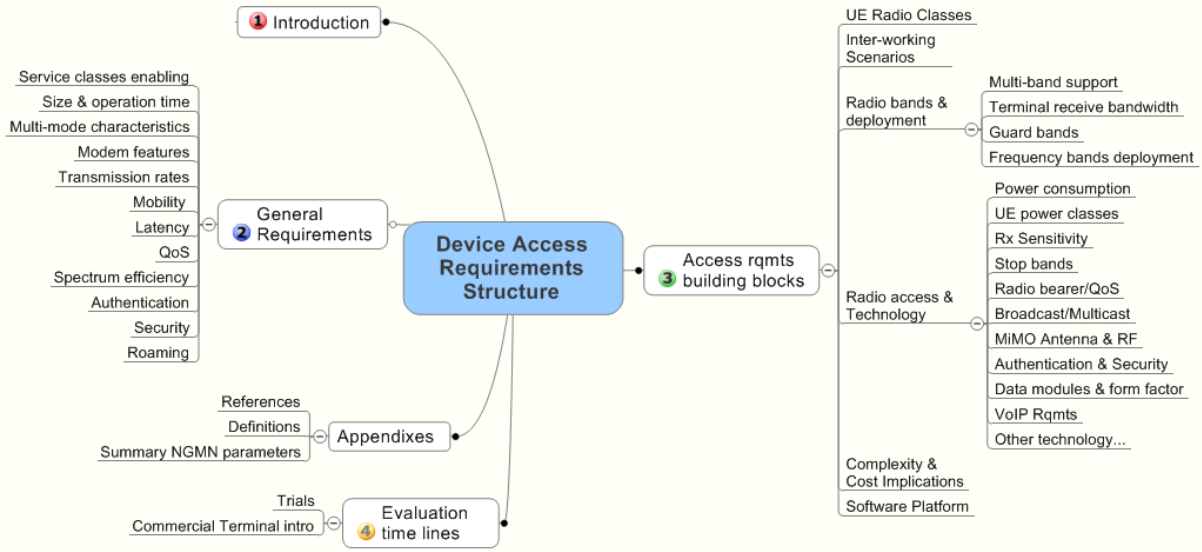
The compliance criteria include the timing of NGMN deployment targets, besides the overall features expected. It regards terminal availability in commercial volumes by 2010 as an important factor to measure compliance.

CONTENT

1 INTRODUCTION

This document provides 'NGMN Radio Access Terminal Requirements[1],[2] as guidelines to implement devices for the commercial introduction of NGMN by 2010.

Figure 1.1 illustrates the main elements covered in the requirements:



The document has four chapters, where after the introduction chapter 2 covers the general requirements based on the recommendations from the NGMN White Paper v3.0. Chapter 3 covers the key access requirements building blocks related to radio and technology aspects. The 'implementation-time-tables' in chapter 4 aim at providing a visibility of the end-to-end delivery plan for NGMN devices; while the 'device trial/validation-time-tables' illustrates the device validation process and schedule in progress with the Trial Group.

[1] These requirements may apply to FDD or TDD depending on the implementation strategy and the corresponding focus and extensions.

[2] Likewise, these requirements may apply to other access technologies beyond 3GPP-LTE/EPC solutions, assuming the necessary extensions and implementation adaptations take place where applicable

2 NGMN TERMINAL GENERAL REQUIREMENTS

2.1 SERVICE ENABLING COMPLIANCE

Competitive service enabling capabilities for NGMN stands as non-negligible priority. Thus, this version introduces compliance requirements to the minimum classes of services outlined earlier in the NGMN White Paper v3.0.

After consultation with chipset suppliers and Terminal manufacturers, Table 2.1 includes the expected timing of compliance for the classes of services, i.e. at the introduction of NGMN (e.g. by 2010). However, it should be noted that the enabling for some services will be device dependent[3]. Thus, devices depending on their design characteristics shall enable or support at least the classes of services illustrated in Table 2.1.

Multimedia Conferencing' and 'Broadcast/Multicast' services, which are device dependent, may be accepted 1 year after NGMN introduction. However, it is expected that suppliers will understand that these services will become a good way to promote NGMN, and therefore will support such features sooner. Furthermore, certain devices, depending on their characteristics, may incorporate only some of the listed services: i.e. some PCMCIA cards e.g. will probably not need to support voice. Likewise, some M2M terminals will not need e-mail. Thus, wherever we indicate 'device dependent,' it means that the type of service will influence the final characteristics of the device.

	Service Classes Supported by NGMN	Driver for NGMN	Readiness@ NGMN Intro	Comments
1	**Synchronous Services:**			
	Voice (e.g., VoIP, PoC)	Med - High	2010	May vary depending on device
	Video Telephony (PS)	High	"	
	Multimedia conferencing	High	2010 + 1	Device depending, expected sooner
2	**Legacy Messaging Services:**			
	SMS	Low	2010	By default
	MMS	Low	"	By default
3	**Real Time Messaging:**			
	Instant Messaging Services	High	2010	
4	**Streaming Services:**			
	Audio	Med	2010	
	Video	High	"	
	Asynchronous Services:			

[3] For simplicity the words 'devices' and 'terminals' are used interchangeably in this document. However, some times we may use a modifier, like 'handheld devices' or handheld terminals to refer specifically to handsets instead PCs or consumer electronics other than handsets

5		*Internet-Like Services*				
			Slow Interactive Sessions	Med	2010	By default
			Fast Interactive Sessions	High	"	
			Download video/audio	Med	"	By default
			Web browsing (per page)	Med	"	By default
			High priority E-commerce	High	"	
			Email (Internet)	Med	"	
		Voice mail				
			Voice mail access	Low	2010	Device dependent
		m2m services				
			Telemetric (background)	High	2010	Device dependent
6	**Trust Based Services:**					
		Security, Safety & Dependability		High	2010	
7	**Broadcast or Multicast Services**					
		e.g. public safety alarms, sport highlights, TV		High	2010 +1	Device dependent, expected sooner

In addition, please note the following in Table 2.1:

- The column "Driver for NGMN" is high for services that are enabled or better supported by the NGMN network such that user experience is positively affected with respect to current generation networks!
- The column "Readiness@ NGMN Intro" indicates the expected date of introduction of the service. The year 2010 is intended to be the start date for services to the end user; thus, the indication 2010 implies that the service is important for the commercial deployment and commercialization of the service to end-users.
- The indication 2010+1 (or +n) indicates that the service may be less mature at NGMN introduction and it is expected to be available 1 (or n) years after first commercialization. The latter also applies to forthcoming requirements
- The colour code of the "Readiness@ NGMN Intro" column reflects the risk that manufacturers associate to the corresponding feature at the given date. Green indicating OK for 2010 delivery and at risk if yellow.

2.2 OVERALL FUNCTIONAL REQUIREMENTS

As partly stated in the terminal section of the NGMN White Paper v3.0, the following updated requirements shall apply to the NGMN terminals:

No	Requirement	Readiness@ NGMN Intro
R1	The compact size of NGMN multi-mode terminals shall support high integration, and as minimum it shall be comparable to state of the art 3G dual mode terminals at that time (e.g. 2009/2010). Also: ▪ it shall enable incorporation into any devices other than handsets or data cards ▪ and shall allow innovation of new devices beyond traditional shapes	2010
R2	Operation time of NGMN multi-mode terminals shall be comparable or better to state of the art dual mode terminals at that time (2009/2010).	2010
R3	In conjunction with enhanced NGMN network capabilities, the performance of NGMN multi-mode terminals shall significantly exceed today's customer experience in the areas of: ▪ terminal reliability, ▪ service access time, ▪ call setup success rates, ▪ call drop rates, ▪ voice quality, ▪ video quality, ▪ download/upload times, and ▪ browsing ▪ Screen rendering time ▪ Support for simultaneous voice, data and video applications ▪ Battery time.	2010

The above shall imply as minimum enhanced: handset platforms, multimedia service quality, user-interface, and better support to meet MTBF targets when compared to today's solutions.

No	Requirement	Readiness@ NGMN Intro
R4	NGMN multi-mode terminals shall support seamless mobility of services (i.e., service continuity) between NGMN network (and in particular its radio access technology) and existing legacy systems as required by the target market (e.g. various permutations of combining NGMN with GSM, EDGE, UMTS, HSPA) without noticeable service interruption. (See more details in section 3.2) ▪ The following implications shall be taken into account: - Mobile platform seamless connectivity through standard interfaces, e.g. USB (incl. 2.0), GPIO, UART (more in R6); and - Integrated one BasedBand (BB) solutions	2010

R5	The modem part of the NGMN terminal's radio access shall be "feature complete" by supporting all mandatory features according to respective UE radio class in the underlying standards. ▪ Product differentiation shall only include "optional features" support as specified in the standards software applications and associated services. ▪ Furthermore, it shall be possible to update the modem part of the terminal (if necessary) via 'Over the Air techniques'.	2010
R6	NGMN modem modules shall support widest possible plug-ability across different market sectors such as consumer electronics and personal computers by ensuring that relevant industry recognised interfaces, e.g.: ▪ Compliance with electrical, mechanical, radio frequency, computer/network interfaces, etc. will be required. As a minimum the following shall be possible for the mobile platform: - Dig RF - UART - GPIO - USB (including 2.0) - SDIO ▪ Likewise, NGMN modems are expected to be comparable in size, even smaller than what is currently available for the state of the art modems during the time of release. - E.g. the evolution of data modules shall be lower or equal to standard PCIe sizes. ▪ Support self discovery of attached platforms: plug-and-play ▪ Provide software hooks for 3rd party software The modem shall also have support for wireless local loop features with acoustic performance meeting 3GPP standards in ▪ Loudspeaker mode ▪ When connected to WLL standard fixed phone and mobile handsets ▪ Music, and services such as group ¾ fax,	2010

In addition, the Table 2.1 (Appendix C) provides an updated summary of the general NGMN parameters that have immediate impact on terminal HW implementation based on the NGMN white paper version 3.0.

This table reflects the essential NGMN requirements, which translates into mandatory items for the 'Terminals Access Requirements' in this document.

In this revised requirements, the table now reflects also the time compliance after the consultation on the preceding requirements paper V2.3

3 DEVICE ACCESS REQUIREMENT BUILDING BLOCKS

3.1 UE RADIO CLASSES

The system data rate requirements has been outlined in [1] and also in [6], these should be also supported by the single UE. Thus, as per recommendations from NGMN and agreed also in 3GPP [2]-[7], [11] and [13], the adopted UE radio classes shall be:

No	CLASS	No. of MIMO Streams	Peak data rate (Mbps)	
R7	1	1	DL	10
			UL	5
R8	2	2	DL	50
			UL	25
R9	3	2	DL	100
			UL	50
R10	4	2	DL	150
			UL	50
	5	4	DL	300
			UL	75

Table 3.1 Sample UE radio classes [13]

NOTE: UE radio classes in Table 3.1 are still under study in 3GPP and the consolidation by the latter may be also adopted in NGMN depending on the outcome. For now the present table reflects NGMN expected classes.

"The above given data rates are thus indicative UE classes with different data rate ranges, and key parameters affecting device complexity and cost. The final definition of other required parameters and features for each class are therefore still for further study [7]." Notice that NGMN recommendations do not reject class 5 with 4 MIMO streams, it simply does not demand it a introduction of NGMN by 2010 if we are to minimize costs and complexity.

Furthermore, the requirements above do not preclude new classes in the future if these are adopted by the concerned SDOs and industry in general.

No	Requirement	Readiness@ NGMN Intro
R11	Power management shall account for sustained speed reception of 10, 25, 50, 100 and 150 Mbit/s in certain usage scenarios as per Table 3.1; however, the 'high data rate handhelds' shall be optimized for *average and edge* data rates rather than peak data rates.	2010
R12	The average data rates optimization shall take into account the Uplink (20 Mbps) and Downlink (40 Mbps) throughput recommendations outlined in Table 2.1 in Appendix C. However, these values may not apply to NGMN TDD systems simultaneously.	2010

In R12 for the case of the TDD system, DL and UL do not occur in the same time instance, and that the DL/UL ratio may change so listed optimized average data rate will not be achieved with one single DL/UL configuration.

3.2 INTERWORKING SCENARIOS

This section outlines inter working scenarios with their priorities and their effect on NGMN terminal requirements. As illustrated in Table 3.2, it indicates the system interaction required, connected modes, idle, etc.

For the 'Inter Access Systems' (Int AS) within the 3GPP, in Table 3.2 we assume that HSPA shall stand as the default 'Fall Back' network for NGMN. The latter is required in the white paper V3.0. This does not preclude other 'fall back' scenarios, which may vary by region or operator strategy based on their predominant technology applied in their commercial networks. E.g. evolved HSPA[4] or eHSPA may also stand as logical 'fallback' for NGMN; however, it may not be as widespread as HSPA due to its later arrival, and because its deployment may be concurrent to that of NGMN, if delays occur in the standards or the implementation.

It is also assumed that falling back to 2G networks with broadband rates does not stand effective. Nevertheless, interworking with GSM for voice service continuity stands a priority.

The interworking between LTE and non-3GPP systems such as WiMAX for example is not seen as a priority for now, as they probably will not be both deployed in the same locations, at least for initial launch.

The inter-working with NGN driven by TISPAN is a non-negligible priority to fully blend NGMN with the converged mobile/fixed environment. Thus, its priority stands high

[4] Often referred as HSPA+

Scenario In relation to coexistence with 3GPP			Inter-Working Priority	Service Continuity	Ready by NGMN Intro	Comments
R13	Intra Access System (AS)	GSM ← →GSM	Existing	Seamless	2010	
R14		UMTS ← →UMTS	Existing	Seamless	2010	
R15		NGMN ← → NGMN	High	Seamless	2010	
R16		Non-3GPP ← → Non 3GPP				
R17	Within 3GPP Access sys.	GSM ← → UMTS	Existing	Seamless for voice	2010	High-data/video limited
R18		GSM← NGMN idle	High		"	
R19		GSM-CS ← NGMN HO	High	Voice call continuity	"	VC
R20		GSM-GPRS ← NGMN CCO	High	Cell Change Order	"	CCO
R21	Outbound Inter AS	GSM-GPRS ← NGMN HO	Low		"	
R22		UMTS ← NGMN idle	High	VCC	2010	
R23		UMTS-CS ← NGMN HO	High		"	
R24		UMTS-PS ← NGMN HO (VoIP)	Low		"	
R25		UMTS-PS ← NGMN HO (data)	High	Data services	"	
R26		UMTS-HSPA ← NGMN (VoIP)	High	Required for fallback	2010	Operator dependent
R27		UMTS-HSPA ← NGMN (data)	High		"	
R28		UMTS-eHSPA ← NGMN (VoIP)	Medium[5]		2010 + 1	Operator dependent
R29		UMTS-eHSPA ← NGMN (data)	Medium[2]		2010 + 1	"
R30	Within 3GPP Access sys.	GSM → NGMN idle	High		2010	
R31		GSM-CS → NGMN HO	Low	VCC	2010 + 1	desired by 2010
R32		GSM-GPRS → NGMN CCO	Medium		2010 + 1	desired by 2010
R33		GSM-GPRS → NGMN HO	Low	Data services	2010 + 1	desired by 2010
R34	Inbound	UMTS → NGMN idle	High		2010	
R35		UMTS-CS → NGMN HO	Low	VCC	2010 + 1	desired by

[5] It may have 'High' priority delivery by 2010 for some operators or regions, e.g. for in Australia

	Inter AS					2010
R36		UMTS-PS → NGMN HO (VoiP)	Medium		2010 + 1	desired by 2010
R37		UMTS-PS → NGMN HO (data)	High	Data services	2010	"
R38		UMTS-HSPA → NGMN (VoIP)	Medium		2010	Operator dependent
R39		UMTS-HSPA → NGMN (data)	High		2010	
R40		UMTS-eHSPA → NGMN (VoIP)	Medium[2]		2010 + 1	Operator dependent
R41		UMTS-eHSPA → NGMN (data)	Medium[2]		2010 + 1	"
R42	3GPP to Non-3GPP Inter As	GSM → non 3GPP				
R43		UMTS ← non 3GPP				
R44		non 3GPP ← NGMN (e.g. IEEE802.16 e, m, WLAN)	Low	VCC if applicable		
R45		non 3GPP → NGMN (e.g. IEEE802.16 e, m, WLAN)	Low	VCC if applicable		
R46		NGMN ← → NGN (i.e. TISPAN)	High	VCC if applicable Data if applicable	2010	Data bandwidth would not be an issue here

Table 3.2 Interworking priority scenarios and introduction timing

Other Notes for Table 3.2:

- In the outbound mode, 'Low' priority for 'UMTS-PS NGMN HO (VoIP)' simply implies that 'UMTS-CS NGMN HO' with 'High' priority is preferred. The latter because UMTPS-PS R99 may not provide the expected voice quality.
- Likewise, in the inbound mode 'Low' priority for 'GSM-CS NGMN HO' or 'UMTS-CS NGMN HO' simply indicate that the number of events may not be as demanding as in the outbound mode because the larger coverage of the legacy systems.
- Mobile-Fixed convergence environment implies primarily service continuity to warrant seamless user experience with contemporary ALL IP networks without pre-assumed system integration, but device intelligence and network inter-working functionality where applicable. In addition, it does not imply access integration.
- It is assumed that HSPA will be dominant over UMTS-PS at the time of NGMN introduction, and hence the focus is on the HSPA side (taking UMTS-PS R99 as granted).
- It is also assumed that data cards or data devices may be introduced first and shortly after multimedia terminals. Thus, both types of devices should be available according to market demands.

- 'High' priority in the context of this requirements draft means mandatory, while 'Medium' and 'Low' may vary based on specs delivery or commercial demands driven by commercial targets or operator strategy.
- Finally, in a network sharing agreement, the terminal will need a mechanism to independently select and hand-off seamlessly amongst different networks. The latter shall occur in accordance with SDO forums, e.g. 3GPP standards.

3.3 UE SEAMLESS MOBILITY CAPABILITIES

As noted above, at the introduction phase NGMN may have spotty coverage; nevertheless, it will be imperative to warrant service continuity to support unspoiled user experience. Thus, the UE needs to contribute to flawless operation in the 3GPP and non-3GPP environments as follows:

No	Requirement	Readiness@ NGMN Intro
R47	A multimode UE shall be able to have radio connection from single radio network at the time, no later than 2010 + 1, if cannot be otherwise.	2010 + 1 at the latest
R48	Seamless mobility shall be supported with single radio operation of 3GPP family, no later than 2010 + 1, if cannot be otherwise.	2010 + 1 at the latest
R49	The UE shall support intelligent inter-system call re-directions during connection setup and release to minimize the need for inter-RAT handovers. E.g. it shall be possible to include optimum filtering and algorithm mechanisms to facilitate best connection. The latter shall conform with related SDO specs and recommendations, as not to impact device certification.	2010

The above will prevent typical Dual radio limitations, e.g.:

- Transmitter interference when transmitters operate at the same time in close frequency domains
- Compliance with health regulations, which may possibly rule against simultaneous operation of two transmitters exceeding recommended power levels, e.g. WCDMA and NGMN (like. LTE, or other).

3.4 RADIO BANDS AND OTHER DEPLOYMENT RELATED TOPICS

The usage of bands will dependent on the deployment scenarios, which may vary region by region and will also strongly depend from operator's commercial strategy on NGMN commercial deployment. Thus, in this section we do not provide prescriptive requirements, rather generic recommendations to converge towards common denominator bands, which may evolve differently for each operator.

3.4.1 MULTI MODE - MULTI BANDWIDTH SUPPORT

To deliver everywhere a flawless service and to satisfy end user expectations, multi-band and multi-standard terminals are required. In roaming or home network situations users shall be capable to access full services. Nevertheless, taking into account all operators requirements at the same time would lead to a complex terminal with an outstanding cost; thus, the implementation of bands must be discussed on an operator per operator basis taking into account market and regulatory constraints. As result, considering legacy and emerging networks all around the world, a generic requirement shall be:

No	Requirement	Readiness@ NGMN Intro
	2G Support (international)	
R50	Quad-band GSM, i.e. 900 & 1800 for EU (and some roaming to Asia) plus 850 & 1900 for US roaming	2010
R51	Quad-band GSM, i.e. 900 & 1800 for EU (and some roaming to Asia) plus 850 & 1900 for US roaming, including 470 and 700 MHz ranges	2010 + 2
	Home Market Requirements (regional)	
R52	*Europe/Japan:* Multi-band 3G incl. WCDMA and NGMN at 900, 1800, 2100, 2600 MHz	2010
R52b	*USA/Canada:* Multi-band 3G incl. WCDMA and NGMN at 700 (US), 850, 1900, and 1700/2100 MHz	2010 + 1
R52c	*Australia:* Same as R52	2010
R52d	*China:* TD-SCDMA at 2010-2025 and 1880-1920 MHz; NGMN FDD/TDD dual mode at 900, 1800, 2100, 2300 and 2600 MHz	2010
	Roaming Requirements (regional)	
R53	*Europe/Japan:* Support of 900, 1800, 2100 and 2600 MHz bands • and one or several of 700, 850, 1900, 1700/2100 allowing roaming in US and Japan; (selection depending on operator request)	2010 + 1
R53b	*USA/Canada:* Support of 700, 850, 1900, and 1700/2100 MHz bands • and one or several of 900, 1800, 2100, 2600 allowing roaming in Europe and Japan; (selection depending on operator request)	2010 + 2
R53c	*Australia:* Support 900, 1800, 2100 and 2600 MHz bands • and 850 allowing roaming in Europe, Japan and US; (selection depending on operator request)	2010 + 1
R53d	*China:* FDD/TDD dual mode roaming on 700, 850, 1900 and 1700/2100 , 2300 and 2600 MHz bands	2010 + 1

Bearing in mind technical constraint such as amplifier linearity over a wide bandwidth, only a subset of bands shall be implemented and with a step approach. Per access technology,

- High bands are defined as frequency bands over 1GHz
- Low bands are defined as frequency bands below 1GHz.

For commercial product, NGMN Project 8 requires implementation of the following:

No	Requirement	Readiness@ NGMN Intro
R54	in a first step: a quad band GSM, a tri band UMTS (2 high and 1 low), a tri band LTE (2 high and 1 low)	2010
R55	in a second step: a quad band GSM, a quad band UMTS (3 high and 1 low), a quad band LTE (3 high & 1 low),and a quad band LTE with (2 low and 2 high frequencies)	2010+1

For bands detailed attribution, the manufacturer is invited to refer works from NGMN group 10 [8].

3.4.2 TERMINAL RECEIVE BANDWIDTH

At introduction NGMN may have non-negligible usage of low bandwidth (BW)options, but later demand upgrade to higher bandwidths while always requiring support for full 20 MHz Rx BW as noted above. The latter implies that there will be other technologies deployed in parallel within the 20 MHz bandwidth range.

Thus, as illustrated in Figure 3.2 for the GSM900 band, it is very likely that a terminal receives within its 20 MHZ BW not only a NGMN carrier but also WCDMA and GSM signals. The latter could be louder if the BTS is closer to the terminal than its own NGMN BTS, and where power spectral density of GSM is even higher than for other technologies. Therefore a single 20MHz wide receive window (as depicted in Fig. 3.2) is most likely not suitable.

No	Requirement	Readiness@ NGMN Intro
R56	Thus, products shall support the complete set of bandwidths from 1.4 MHz up to 20 MHz.	2010
R57	The performance of the components (filters, AGC, ADC) shall be suitable for multi Radio Access Technology neighboring.	2010
R58	The design shall ensure proper performance during acquisition/ PLMN search in such scenarios.	2010

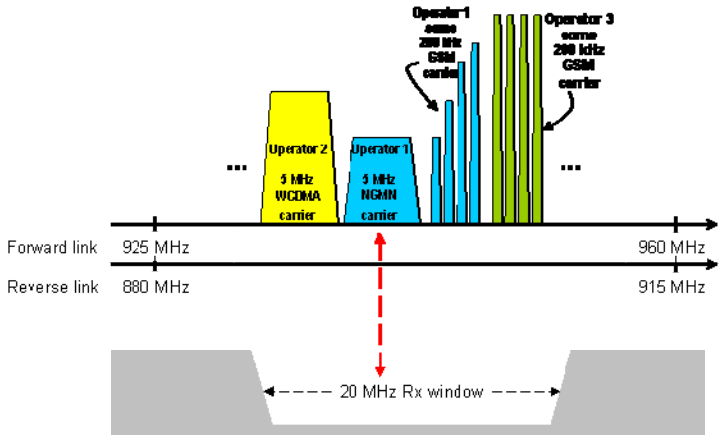


Figure 3.2 Frequency Bandwidth Co-existence

3.4.3 GUARD BANDS CONSIDERATIONS

The initial proposal for the guard bands is to apply the 3GPP and CEPT rules. Likewise, for the edges of the bands follow what is defined by the CEPT / 3GPP, as well as national regulations where required.

3.4.4 FREQUENCY BANDS DEPLOYMENT PROJECTIONS

In Table 3.3 rows Ph1, Ph2 and Ph3 phases illustrate the progressive usage of bands throughout NGMN introduction. Clearly, only one band can demonstrate the proof of concept phase. However, starting with the trials a wider number of bands would be required to meet key deployment scenarios. Ph5 illustrates the commercial maturity where more bands will come into operation. Ph6 illustrates the use Digital dividend bands besides already exploited in mature commercial deployments.

		Digital dividend /470-862 (~500)	x 700 (US)	V 850	VIII 900	xxx 1500/ 1600	III 1700/ 1800	II 1800/ 1900	IV 1700/ 2100	I 1900/ 2100	xx 2300[6]	VII 2500/ 2600
R59	Ph1: Proof of concept	*		*	*	*	*	*	*	*	*	*
R60	Ph2: Interoperability									X	X	X
R61	Ph3: Trial				X		X			X	X	X
R62	Ph4: Early commercial (Europe 2010)				X		X			X		X
R62b	[X]Ph4: Early commercial (US/Canada 2010-12)	X	X	X				X	X			

[6] To be confirmed for regional requirements, e.g. the US

		Digital dividend /470-862 (~500)	x 700 (US)	V 850	VIII 900	xxx 1500/ 1600	III 1700/ 1800	II 1800/ 1900	IV 1700/ 2100	I 1900/ 2100	xx 2300[6]	VII 2500/ 2600
R62c	[xx]Ph4: Early Commercial (China 2010)										X	X
R62d	[xxx]Ph4: MSS (L-Band US region 2010)					X						
R63	Ph5: Commercial (e.g. 2012)				X		X	X		X	X	X
R64	Ph6: later date (beyond 2012)	X			X		X	X		X	X	X

Table 3.3 Frequency deployment scenarios

Note: It is assumed Ph 1-2 will happen bilaterally or data will be provided independently by the vendor, while Ph 3 is required at introduction of NGMN by 2010. Ph4 will vary as per illustration in Table 3.3 and assumptions below:

Assumptions:

*) During proof of concept any of these bands may be used. Nevertheless, it is recommended to use high bands, as well as low bands, which are also intended for use in later phases.

During the Interoperability tests at least band I and VII have to be supported to ensure proper interworking.

Likewise, during trial phases all the bands available in the commercial phase should also be supported.

For Europe the 2500/2600 MHz range stands as the 1st priority until commercial introduction and thereafter, because it will enable broadband in the transmission rates recommended by NGMN. Here it is implied that this spectrum will be made available by the corresponding regulatory bodies with bands of at least 20 MHz

For Japan the primary focus will be in the 2100 MHz range. All other frequency ranges would be used based on availability, which may vary region by region or operator by operator according to internal strategies. Likewise, the bandwidths will also depend on space availability. Thus, it could be 20, 15, 10, or 5 MHz channels.

[x] For initial deployments in the United States the 850, 1900, 1700/2100 and 700 MHz bands should be considered as candidates in the 2010-2012 timeframe. One or more of these bands may be the primary focus in this timeframe. This same situation also applies to Canada with the exception of the 700 MHz band. It should be noted that 850 and 900 MHz will also apply to Australia by the 2010 period.

[xx] For China the 2300 and 2500/2600 MHz stand as the 1st priority, because it will enable broadband in the transmission rates recommended by NGMN as well as offer an opportunity to make 20 MHz bandwidth come true.

[xxx] L-Band (1500 – 1600 MHz) for LTE network deployment based on operator demands and or regional strategy in the 2010 timeframe

The spectrum usage assumes that to minimise the number of bands for lower costs/complexity), terminals shall support from the UMTS/NGMN bands in the range of: 900, 1800, 2100 and 2600 MHz bands, with quad band GSM. Thus US roaming with such terminals would be on GSM only. The latter does not preclude niche terminals/devices, which could be developed in the early days for roaming in US on more advanced technologies and become widespread with time

Furthermore at later dates low price terminals with reduced band/technology support might become possible, depending on the progress of refarming.

3.5 RADIO ACCESS AND TECHNOLOGY RELATED DETAILS

This section covers specific radio access details like overall power management, UE power classes, Rx sensitivity, etc. For all practical purposes for the latter here follow the 3GPP proposal [7] and might change depending on the outcome of discussions within the respective SDOs.

3.5.1 POWER CONSUMPTION CHARACTERISTICS

Due to the importance of having efficient and highly performing devices not only in terms of features and high transmission rates, but also in the power consumption to warrant sufficient energy autonomy, the following requirement is imperative.

No	Requirement	Readiness@ NGMN Intro
R65	NGMN devices that will enable truly broadband wireless mobile with very high transmission rates capabilities shall optimize power management consumption per element and end-to-end.	2010

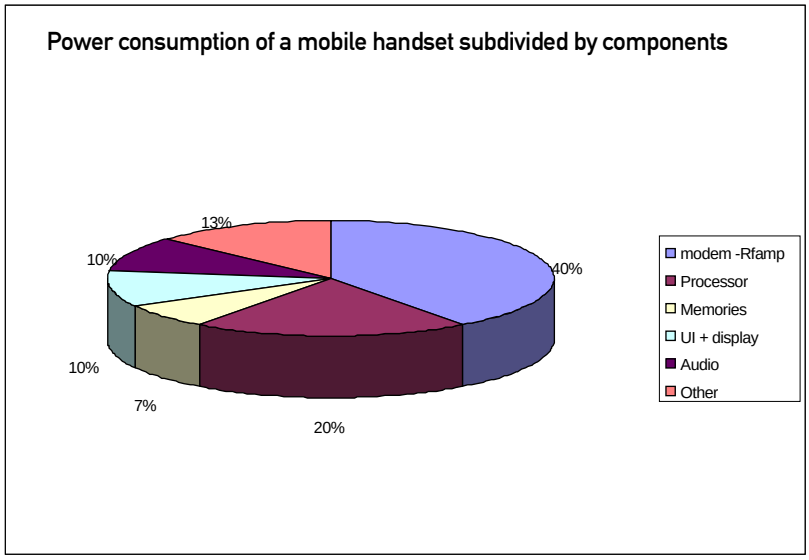


Figure 3.1 Power consumption distributions in mobile devices [12]

Figure 3.1 illustrates the distribution of power consumption as per key elements from recent industry analysis. It is expected that by 2010 at the time of NGMN introduction, these main elements like the modem, processor, UI + display, etc, will be up to 30 % more efficient in power consumption. Thus,

No	Requirement	Readiness@ NGMN Intro
R66	Device manufacturers shall exploit features available in chipsets and Operating Systems for Power and Energy Management such as to optimize the total power consumption of the handset	2010
R67	Similarly, power management shall be optimized as to allow effective support of new innovative services, e.g. high-speed Internet, real time streaming, blogging, uploading/downloading large data files, etc., besides that of common services of today.	2010
R68	New benchmarking of power usage proportions shall be possible to go beyond that of classical services (e.g. voice, SMS).	2010
R69	All power consumption levels shall be benchmarked with contemporary 3G devices for better efficiency and higher interfaces effectiveness, (i.e. they are common and fully compatible) so that certification and testing are standard and simple procedures.	2010
R70	'Always On' shall be fully optimized from the beginning and impact on standby times, as well as battery consumption shall be lower than competing technologies at the time of introduction and decrease continuously thereafter.	2010

The above implies clear breakthrough in power consumption technologies and electronics altogether. For high data rates the following modem size and design principles shall be applied depending on usage, i.e. handhelds of devices with embedded communications:

No	Requirement	Readiness@ NGMN Intro
R71	The terminals shall implement effectively the power saving modes defined by the standards and the standby time shall be optimized in such a way that its duration is not penalized by the size of the modem.	2010
R72	High data rate modems shall employ improved technology to minimize current leakage and power consumption	2010
R73	Likewise, power amplifiers shall employ improved technologies such as to optimize power consumption at high rate transmissions	2010
R74	Advanced heat external/internal dissipation techniques shall be applied to minimize overheating on devices due to high data rates	
R75	Power management in high data rate devices shall also be optimized for *average and edge* data rates rather than peak data rates	2010

3.5.2 UE POWER CLASSES

No	Requirement	Readiness@ NGMN Intro
R76	The NGMN terminal shall support a maximum output power of +23dBm, (working assumption in 3GPP RAN4). Depending on the modulation scheme used, other maximum output power targets and tolerance limits shall apply from what is consolidated/defined by the relevant SDOs, (e.g. 3GPP RAN4: TS36.101).	2010

3.5.3 RX SENSITIVITY

No	Requirement	Readiness@ NGMN Intro
R77	For NGMN it shall adopted more aggressive values than those recommended for LTE by 3GPP in order to enable a wider range of deployment scenarios.	2010
R78	Especially, it shall be addressed ranges below 1GHz frequencies, where over the air performance will become critical due to excessive implementation losses.	2010

3.5.4 STOP BANDS AND ADJACENT CHANNEL BLOCKING

The RF transceiver will vary depending on the number of radio access to be supported, (e.g. only LTE or multi-mode including HSPA and 2G). A HSPA transceiver chain not optimized for LTE, would lead to either separate RF path (with an obvious cost impact), or require a new single receiver design (supporting EDGE/HSPA/LET), which would be cost optimized but would be complex to implement and tune.

No	Requirement	Readiness@ NGMN Intro
R79	Therefore, new compact and cost optimized receivers shall be designed for LTE, e.g. that which can support LTE/HSPA/EDGE/GSM/xCDMA, or any other combination depending on what market is addressed besides LTE.	2010 + 1
R80	Dedicated configurations of DTX/DRX functionality shall be possible in devices incorporating NGMN air interface and WLAN/PAN, in order to allow interference-reduced operations when necessary. • E.g. a UE shall be able to autonomously suppress WLAN/PAN receiver operation when its NGMN air interface is active.	2010

3.5.5 RADIO BEARER/QOS

No	Requirement	Readiness@ NGMN Intro
R81	Comply with the white paper requirements on QoS and follow also recommendations by related SDOs.	2010
R82	In addition, there shall be a minimum granularity of 8 levels for UL and DL per UE in parallel (i.e. the minimum number of radio bearers/QoS levels per UE shall be 8). Comply also with: • Data integrity, • Response time, (minimum signalling) • Throughput, • HO criteria in non-3GPP systems • Minimum or non-data buffering in handset to minimize impacts on latency time	2010
R83	In order to support signalling in future proof manner, a sufficient number logical channels shall be supported by a UE, (e.g 16 channels shall be possible following SDO specs).	2010
R84	Any NGMN UE shall support the concept of "prioritized bit rates (PBR)" as defined in 3GPP E-UTRAN stage 3, in order to avoid the starvation of lower priority services/bearers.	2010
R84b	QoS features to support an integrated emergency services[7]	2010

[7] E.g. to meet 'homeland security' demands

In the following we illustrate some of the radio bearers and other access technology details already under specification completion in 3GPP RAN. Thus, it is expected that these and more shall be completed early enough, (e.g. end 2008), to assure devices availability by 2010. These include (non-exhaustive):

No	Requirement	Readiness@ NGMN Intro	No	Requirement	Readiness @ NGMN Intro
R85	Physical and transport channels	2010	R95	Long CP supporting MBSFN	2010
R86	PDCP, MAC & RLC support	"	R96	Extended/repeated RACH bursts	"
R87	DRX	"	R97	Mixed carriers MBSFN awareness	"
R88	System information reception	"	R98	Synchronization Channel (SCH)	"
R89	Paging reception	"	R99	Downlink signalling – PDCCH channel	"
R90	Open and closed power control	2010	R100	CQI generation and signalling	2010
R91	Link adaptation including measurement reporting	"	R101	Dedicated reference symbol (RS) mode, (optional for FDD, but mandatory for TDD)	2010 + 1 for TDD
R92	ARQ and HARQ	"	R102	ACK/NAK signalling , (PHICH and PUCCH)	2010
R93	Ciphering and integrity protection	"	R103	VRB specification	"
R94	Idle reselection (including tracking area	"	R104	Macro Cells, i.e. short CP for unicast, 1 ms PRACH burst	"

3.5.6 FDD AND TDD RELATIONSHIP

NGMN FDD/TDD dual mode terminals brings true global roaming capability to NGMN technologies, which means users will be able to have consistent experience all over the world regardless the deployment scenario of NGMN FDD/TDD technologies. NGMN FDD/TDD dual mode will also merge the separated FDD and TDD chipset markets into one unified dual mode chipset market, improving economy of scale of NGMN chipsets significantly.

Consequently, as indicated in chapter 1, the requirements may apply to either FDD or TDD assuming the necessary extensions and implementation focus are identified for the latter. Hence, combined FDD/TDD priority, based on regional demands or operator deployment strategy, can also apply by 2010. However, FDD or TDD shall not delay each other's delivery if markets demand it for 2010; therefore, manufacturers are also to consider solutions like voice, data and dedicated broadcast TV services over TDD by 2010 timeframe.

Finally, in the time frame beyond 2010, (assuming it has been specified in the standards), it shall be possible to have capabilities to support channel bonding8 between two or more carriers in the downlink including two or more FDD carriers, TDD carriers, and, FDD and TDD carriers.

3.5.7 BROADCAST AND MULTICAST PRIORITIZATION

No	Requirement	Readiness@ NGMN Intro
R105	NGMN requires inherent and effective eMBMS features exploiting the parallel characteristics from the access and it shall be enabled in devices	2010 + 1
R106	It shall be optimized for devices offering TV application or TV oriented data services.	2010 + 1
R107	MBSFN with 7.5 sub-carrier spacing shall be possible NGMN intro + 1, (applies only to LTE)	2010 + 1
R108	Shall establish all necessary enablers and hooks to corresponding devices types to warrant eMBMS as an important driver for new multicast/broadcast applications at NGMN introduction	2010
R109	Mixed carrier MBSFN reception shall be possible from the introduction	2010

3.5.8 DEGREE OF MIMO - ANTENNA – RF DESIGN ISSUES

The following recommendations shall apply for MIMO antenna subsystems:

No	Requirement	Readiness@ NGMN Intro
R110	A combined subsystem (above and below 1GHz), e.g. 2.6 GHz and 900 MHz shall not exceed a volume of 30% over that of single subsystem below 1 GHz e.g. 900 MHz	2010 + 1
R111	Efficiency (e.g. free space) shall not decrease for more than 30 % of that of 2.6GHz when below 1GHz, e.g. 900 and 700 MHz.	2010
R112	Efficiency (e.g. free space) shall not decrease for more than 20 % of that of 2.6GHz when below 1GHz, e.g. 900 and 700 MHz.	2010 + 2
R113	In order to fulfil the minimum transmission rate requirements, mandatory 2x2 MIMO is compulsory. It shall be forward compatible with higher levels when necessary for special devices other than handsets.	2010
R114	There shall e.g. as minimum support for the mandatory 3GPP LTE transmission features enabling MIMO: • Spatial multiplexing rank-two transmission for 2 Tx antennas • Spatial multiplexing rank-one transmission for 2 Tx antennas • Transmit diversity transmission for 2 Tx antennas • Single-antenna port transmission	2010

[8] I.e. multicarrier in order to maximize channel spacing for wider bandwidth if the expected continuous spectrum is not available.

No	Requirement	Readiness@ NGMN Intro
R115	MU-MIMO, TX- diversity, and beam-forming, shall be possible at introduction, e.g.: • Small Cycle Delay Diversity (CDD) • Large Delay CDD • Frequency selecting pre-coding • Beam-forming with dedicated reference signals for demodulation	2010
R116	It shall be possible to have absolute power control command schemes from the beginning	2010
R117	Distributed transmission mode shall be implemented	
R118	Antenna position and volume shall take into account body effect, correlation (e.g. below 0.3), and mutual coupling between the antennas	2010
R119	Special care shall be taken to ensure proper performance of MIMO schemes in the below 1GHz range. This might involve special antenna design and placement	2010 + 1
R120	Overall RF system efficiency shall be high enough to ensure TRP and TIS values better than the minimum SDO's requirements	2010
R121	LTE PA efficiencies shall be in the range of that in WCDMA or better, with a minimum degradation for multi-band cases.	2010

3.5.9 RELATION TO 'HSPA+' AND ALSO EDGE+

No	Requirement	Readiness@ NGMN Intro
R122	The introduction or development of NGMN (e.g. LTE type) devices shall not be delayed by the delivery of enhanced HSPA or EDGE devices.	2010

3.5.10 AUTHENTICATION AND SECURITY

No	Requirement	Readiness@ NGMN Intro
R123	Each NGMN terminal shall support the defined and mandatory encryption algorithms as recommended by the respective SDOs (e.g. for E-UTRAN in 3GPP).	2010
R124	The authentication shall be based on USIM. Additional authentication options will be considered for inclusion into the future evolutions of the system	2010
R125	Biometric authentication shall be required at commercial + 1 at the latest as mandatory	2010 + 1
R126	Standard security steps are required, e.g. at minimum the following shall be supported: • System-level security solution that intimately interleaves hardware and software technologies to provide the highest level of security, which supports .e.g.: o Terminal Security (i.e. secure Flash & Boot, IMEI & SIM Lock) o Value-Added Secure Services (DRM, Enterprise, Payment and Device Management/FOTA) o (HW) Chip-level security (e.g. secure DMA, secure interconnection) o (HW) secure execution and storage environment o (SW) secure middleware component o (SW) secure OS package	2010

No	Requirement	Readiness@ NGMN Intro
	o One time ROM encryption o Public key encryption o Secure Basedband Processor preventing malicious applications to attack any SW handling IMEI o Full compliance with other IMEI handling requirements (e.g. 3GPP & OMPT), e.g.: o IMEI must be bound to device (Flash is not enough) o IMEI tampering must be prevented or detected at all times o Network access denied if IMEI tampering has been discovered o Secure authentication boot process for IMEI protection and components handling	

3.5.11 DATA MODULES AND FORM FACTORS

The proposed device segmentation shall be followed:

No	Requirement	Readiness@ NGMN Intro
R127	Data modules working with a PC (USB dongle, embedded module ,Express data card….), which are dependant on the PC power (no specific requirement on power consumption then, but it shall be sufficiently efficient not to degrade the PC's power consumption levels)	2010
R128	Data only device (new form factor to take benefit of the new bit rate for applications such as camera and camcorder with modem capability)	2010
R129	Device with Voice service as priority	2010
R130	Full multimedia devices allowing e2e broadband data and voice shall be possible no later than one year after NGMN introduction. It could be that some markets demand it earlier.	2010 + 1 (at the latest)
R131	The form factor for NGMN (e.g. LTE) type devices shall have minimum impact from those already in the market, e.g. HSPA; in fact in time it shall improve.	2010

3.5.12 VOIP REQUIREMENTS

The proposed device segmentation shall be followed:

No	Requirement	Readiness@ NGMN Intro
R132	By 2010 timeframe, all 3 GPP mandatory features to deliver a seamless VoIP service shall be included into products: o codecs, (including codec for HD voice) ▪ NB-AMR shall be supported with datarates of 12.2, 7.95, 5.9 and 4.75 kbps ▪ WB-AMR shall be supported with datarates of 12.65, 8.85, and 6.6 kbps o support of seamless mobility (VCC) within and between RATs without any notable interruption for the user. o QoS o VoIP support / Codecs / RoHC (RFC 3095 and 4815) o Terminals shall support Voice Quality Enhancement (VQE) through inclusion of noise suppression devices and with minimum performance requirements as per 3GPP TS 26.077 for NB voice and similar for WB voice, when such devices are not included in the network o To provide an adequate echo protection, ▪ E.g 'Terminal Coupling Loss' shall be not less than 46 dB as per 3GPP TS 26.115 v.7.0.0 o In a reasonable time scale, AMR WB+ codec has to be supported; otherwise, MMT (multimedia telephony) features will be limited to speech only	2010

3.5.13 OTHER TECHNOLOGY REQUIREMENTS

Since the selection of clock speeds will be implementation depending, it should be possible to have speeds in the range of 1 GHz or higher and also use of more than one processor with lower clock speeds. Thus, without restricting innovation and creativity to introduce technology enablers when appropriate, the following shall be applied:

No	Requirement	Readiness@ NGMN Intro
R133	o HW accelerators at the: ▪ BB, optimized for high data rates, ▪ physical layer, optimized for critical functions, e.g. FFTs DFTs and Coding/Decoding, ▪ Layers 2/3 o Communication subsystems	2010
R134	o Power reduction techniques, e.g.: ▪ sleeping transistors ▪ dynamic voltage and frequency scaling ▪ Multi-core architecture	2010
R135	o Silicon processing, e.g. 45nm to 32 nm	2010 + 1

No	Requirement	Readiness@ NGMN Intro
R136	o Open Physical Interfaces, e.g. follow MIPI recommendations. Consider ; ▪ USB 2.0, ▪ WLAN, ▪ DifRF, etc,	2010
R137	o Apply analogue and digital filtering to realize variable-bandwidth filtering features	2010
R138	Positioning enabling shall be possible from the introduction	2010
R139	Home NodeB specific support (e.g. home GW features) from the terminal side shall be possible as needed from NGMN introduction.	2010

3.6 COMPLEXITY AND COST IMPLICATIONS

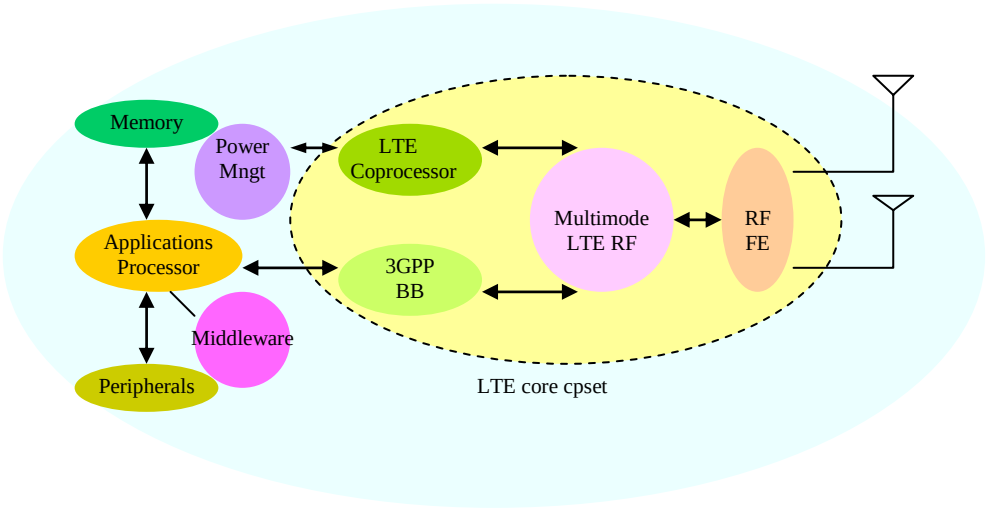


Figure 3.3 Multimode LTE mobile terminal sample platform

A per bubble reference example (only) in Figure 3.3, it is recommended to consider the following requirements to minimize complexity and cost increases:

No	Requirement	Readiness@ NGMN Intro
R140	LTE and Legacy processors to share supporting subsystems e.g. power mngt, multimode RF ICs, as to maximize common components and thereby reduce physical complexity in the UE	2010
R141	Optimize BB modem solution through appropriate buffer sizes and receiver algorithms according to the defined UE classes as not to exceed 2x2 MIMO capabilities on handsets at introduction	2010

No	Requirement	Readiness@ NGMN Intro
R142	As result, complexity increase and cost shall not exceed 10-15 % e.g., over today's multi-mode WCDMA systems at the time of NGMN introduction.	2010
R143	In time e.g. after 2012 and with large volumes, such increase shall be offset and the integration process shall also progress and overall complexity and cost shall decrease	2010 + 2

3.7 SOFTWARE PLATFORM

For completeness in the overall Terminal mobile platform requirements, this application section does also require fulfilment of the following:

No	Requirement	Readiness@ NGMN Intro
R144	The platform shall support: • Deep modularity with an ability to sustain: o Plug-and-Play applications, e.g. open APIs for navigation services o Software upgradeability over the air, e.g. OMA 'Firmware Over The Air' FOTA without need for rebooting the device The above shall *also* refer to OMA DM (Device Management) and SCOMO (Software Component Management Object) as well as FOTA	2010
R145	Shall support 'connectivity and mobility parameters for dynamic adaptation of service parameters, such as QoS, transmission rates, etc.	2010
R146	Shall support efficient 'Multithreading'	2010
R147	Shall support application interworking between the native environment, e.g. web-browser, which include 'Browser Widgets' , Java and Flash Lite, (as well as, any other potential environments as they emerge in the market)	2010
R148	If the device implements a web browser, the browser shall be able to render full HTML, JavaScript and typical popular web pages, not only a mobile subset. This requirement recommendation shall follow w3c.	2010
R149	Shall support Abstraction for add-on technologies (e.g GPS, short range connectivity such as Bt, UWB, etc) with their longer term evolution cycle in mind	2010
R150	Shall support Cross platform pollination by adopting 'Open C' in the first instance or any other emerging standards as they become established	2010
R151	Shall support fine tuning the software platform to cope with high throughput data connectivity	2010
R152	Shall support UI 'plug in' components to transcode high level UI design to suitable corresponding codes to run under disparate terminal platforms, e.g.: o Intuitive task-oriented visual user experience o Multimodal user experience through graphics and vocal functions o Foolproof user-commands with intelligent feedback framework o Automated command sequence with minimum interaction	2010

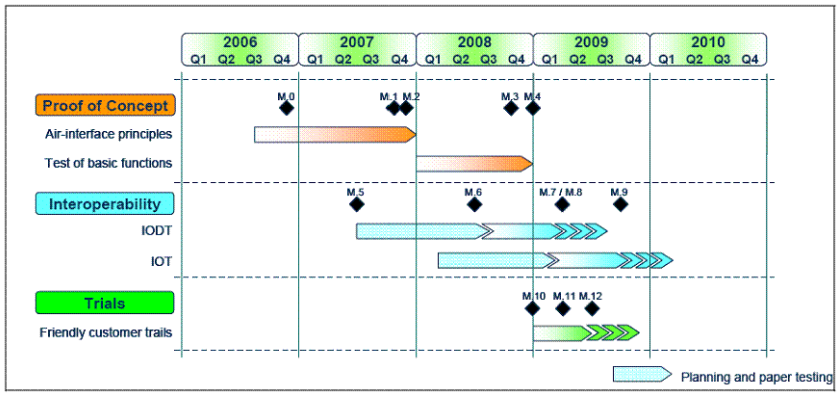
No	Requirement	Readiness@ NGMN Intro
R153	Shall support Platform security by enabling/disabling access to APIs with a fine grain granularity, e.g.: o ROM secure boot architectures for UE software o Secure storage HW for key accelerators o Secure execution run time environment for critical certificate codes, etc.	2010
R154	Support for identity verification, e.g.: o SoftSIM o Biometrics mandatory at Intro+1yr	2010
R155	Shall support digital document authentication, e .g.: o OMA DRM 2.1, Janus DRM, etc. o Secure middleware components to launch trusted applications, etc.	2010
R156	Shall support protecting personal data from unauthorised access	2010

4 EVALUATION TIME-LINES AND CONCLUSIONS

4.1 TRIALS

The overall device assessment and functional evaluation shall take into account the requirements outlined in this draft. However, the evaluation progress will depend on the performance milestones to be detailed by the NGMN Trial Group.

Table 4.1 [9] illustrates an initial trial schedule and milestone plans. Other updates may be obtained from trial team. NGMN will closely collaborate with industry devices development teams to gauge the readiness of its terminals.



M.0 Start of PoC activity
M.1 SISO L1-L2 PoC
M.2 MIMO L1-L2 PoC
M.3 RRM PoC
M.4 Mobility PoC
M.5 Start of IOT planning
M.6 IODT planning
M.7 First IODT ready
M.8 IOT planning finished
M.9 First IOT ready
M.10 Trial planning finished
M.11 Setup of trial network finished
M.12 Network testing and demonstrations

Table 4.1 NGMN trial key milestones [9]

** TDD PoC test will be finalised before the end of 2008. For IODT, IOT and Trials, TDD will keep the same step with FDD, but will not delay or impact the latter.

4.2 COMMERCIAL TERMINAL INTRODUCTION

NGMN stipulates that devices will be available in commercial volumes by 2010 at the time of the 1st deployment periods. However, the process must follow detailed testing, functional validation, field trials and pre-commercial IOT, roaming and interworking validations. The certification process shall also start earlier than traditionally happens, e.g. UMTS, which happened only after the products were out.

Figure 4.2 illustrates the NGMN system and device delivery visibility, which also includes the specification period of the standards. The latter assumes full inter-system harmonized specifications by beginning 2010.

	2007				2008				2009				2010			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Standards	higher layers complete (4Q/07)				All standards complete (4Q/08)				Bug free standards for system optimization (2Q/09)				Complete 3GPP/non-3GPP Intersystem harmonized standards (2Q/10)			
	All L1 aspects complete (4Q/07)															
COMMERCIAL SYSTEM	First device prototype implementation (4Q/07)				First pre-commercial Chipset samples (3Q/08)				First commercial Chipset samples (1Q/09)				First commercial network launch (2Q/10)			
					Initial IOT tests (2Q/09)				First form factor accurate prototype (2Q/09)				First commercial handset(2Q/10)			
									First e2e IOT tests (2Q/09)							

Table 4.2 NGMN System and devices introduction time table

4.3 CONCLUSIONS

These requirements embody the guidelines for the next generation mobile devices. It has been produced based on Operators expectations in consultation with related Device Industry. Thus, it has the balance of what is possible and can serve as an initial reference for the implementation of NGMN terminals in commercial volumes by 2010.

A REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

[1] NGMN White paper V3.0

[2] 3GPP TS 45.002

[3] 3GPP TS 25.306

[4] 3GPP TS 34.108

[5] 3GPP TR 25.993

[6] 3GPP TR 25.913

[7] R2-071332 (3GPP-RAN WG2 #57 bis, March 25th-30th, 2007 Malta

[8] Technical Working Group – TWG Project 10 "Initial Deployment Scenarios" Raimund Walsdorf et al. May 24, 2007 Incl. draft extensions for US market

[9] NGMN Trial working group, by Tino Puch, TMO 2007 from LSTI work.

[10] 3GPP TR 36.300

[11] As per 3GPP draft R1-073439

[12] The 3 Ps of mobile handsets, D. Ford, iSupply, Nov 2006

[13] 3GPP draft R1-080157

B DEFINITIONS, SYMBOLS AND ABBREVIATIONS

Main Abbreviations

BB	BaseBand
FDD	Frequency Division Duplexing
GPIO	General Purpose Input/Output
GSM	Global System for Mobile communications
HSPA	High Speed Packet Access
IMEI	International Mobile Equipment Identity
MIMO	Multiple Input Multiple Output
MIPI	Mobile Industry Processor Interface
NGMN	Next Generation Mobile Networks
OMPT	Open Mobile Terminal Platform
SDIO	Secure Digital Input/Output
TDD	Time Division Duplexing
UART	Universal Asynchronous Receive/Transmit

UE	User Equipment
USB	Unversal Serial Bus
USIM	UMTS Subscriber Identification Module
VCC	Voice Call Continuity
VoIP	Voice over Internet Protocol

C SUMMARY NGMN BASIC PARAMETERS

Functional criteria	Priority	BASIC FEATURES	UE impact	Ready at NGMN into?	Comments
QoS Support R157	Essential	e2e QoS throughout all segments	Implementation of standardised QoS features is mandatory	2010	Fixed & mobile
	Preferred	Optimum e2e QoS with service continuity throughout		2010	
Mobility Support R158	Essential	Seamless mobility mngt across all bearers with service continuity through a minimum of 120 km/hr	Support of seamless mobility procedures in line with Network capabilities is required. UE capabilities to support 350 up to 500 km/hr speeds based on SDO specs, e.g. voice calls and data transfer in high speed trains.	2010	Fixed & mobile
	Preferred	Seamless mobility management based on intelligent infrastructure e.g., a unified network & service layer to serve in all environments		2010	
Uplink Data Rates R159	Essential	Peak: 30-50Mbit/s (e.g., 1 transmit antenna at UE per 20MHz carrier, scaling linearly with bandwidth)	Platform support for UL data rates of 50 Mbit/s is mandatory; peak platform rate and 20 Mbits/s UL average throughout is also mandatory.	2010	
	Preferred	Peak: >50Mbit/s. The average instantaneous bit rate for active users shall be greater than 20 Mbps, and this shall apply for the network as a whole assuming all cells are interference limited. (per 20MHz carrier, scaling linearly with bandwidth)		NP	No position at this time

Functional criteria	Priority	BASIC FEATURES	UE impact	Ready at NGMN into?	Comments
Downlink Data Rates R160	Essential	Peak: > 100Mbit/s (e.g., 2 receive antenna at UE per 20MHz carrier, scaling linearly with bandwidth)	Platform support for DL data rates of 100 Mbit/s is mandatory; peak platform rate and 40 Mbits/s average DL throughout is also mandatory; and DL MIMO support is mandatory	2010	
	Preferred	Peak: > 100Mbit/s. The average instantaneous bit rate for active users shall be greater than 40 Mbps, and this shall apply for the network as a whole assuming all cells are interference limited. (per 20MHz carrier, scaling linearly with bandwidth) Higher rates for LOS & indoor		NP	No position at this time
Always-on Support R161		Highly cost-effective always-on over PS Selective leash mechanism for optimum transport and utilise 80% less overall network resources	Highly efficient implementation of always-on is key	2010	
Core, RAN & E2E Latency R162	Essential	Core < 10 ms, RAN < 10 ms, < 30 ms e2e	Any delays introduced by the terminal and interconnect must be well below 5ms; preferred <1ms	2010	(Roundtrip Time)
	Preferred	Core < 5 ms, RAN < 10 ms, < 20 ms e2e		2010	
Spectrum efficiency R163	Essential	3…5 X HSPA and EVDO	Implementation of diversity and highly efficient advanced receivers supporting interference mitigation is key	2010	
	Preferred	6…8 X HSPA and EVDO		No	Later stage
Authentication Support R164	Essential	xSIM based (including integrated networks)	Support of USIM is mandatory; extensions are tbd	2010	
	Preferred	xSIM and other methods (e.g. biometric) based for 3GPP & NGMN		2010 + 1	Device dependent

Functional criteria	Priority	BASIC FEATURES	UE impact	Ready at NGMN into?	Comments
Security Support R165	Essential	Efficient ciphering, built-in VPN encryption, integrity of communication, secure voice, and protection against SPAM, Viruses, etc.	Support standardised ciphering algorithms; HW support for high data rate encryption & decryption for use by application layers	2010	
	Preferred	Self-defending for secure connectivity		2010 + 1	A must in UE
Roaming Support R166	Essential	QoS based global roaming & interworking (as per class of services defined) Full compliance with latency & mobility recommendations	Mandatory for UE when matching with network capabilities	2010	
Broadcast & Multicast Support R167	Essential	Support of broadcast, multicast and unicast services to subscribers of all environments, e.g. Fixed and Mobile	Mandatory hooks for corresponding devices	2010	Device dependent
	Preferred	Support for optimised control of its own inherent broadcast/multicast & unicast services distribution taking into account the extra large broadband access capability		NP	No position at this time
Enablers & Services R168	Essential	Highly cost effective, personalised location / presence & group management capabilities with integrated service layer for fixed / mobile	UEs interacting with common service platforms	2010	important for launch
	Preferred	Optimised and harmonised service layer based on open standards		2010	A must for business
Real-time & Streaming Support R169	Essential	RT, conversational & streaming in PS across all required bearers Integrated core support enabling to phase out of CS domain	Will vary with type of device	2010	May not apply to 1st data devices
Open and Standardised Architecture R170	Essential	Integrated solutions providing inter-working with legacy networks and an access agnostic core network	UE compliance will depend on network capabilities	2010	

Functional criteria	Priority	BASIC FEATURES	UE impact	Ready at NGMN into?	Comments
IPv4/ IPv6 support R171	Essential	Optimised support of IPv4 & IPv6 with interworking	Mandatory in all UEs	2010	
R172	*Preferred*	Fully integrated support of IPv4 & IPv6 with interworking	By default in UE if available in network side	2010	
TERMINALS COST EFFICIENCY CRITERIA					
Integration & Convergence R173	Essential	One integrated network with RAN, Core and Transport with convergence fixed & mobile where applicable	UE compliance will depend on network capabilities	2010	
R174	*Preferred*	Extra-high speed broadband radio with seamless inter-working with incumbent networks		NP	No position at this time
Access Management R175	Essential	Access is negotiated between the terminal & network under the guidance of the network	Mandatory in all corresponding UEs	2010	
R176	*Preferred*	Access is optimised for the application & terminal under the guidance of the network with user preferences		2010	
Terminal Support (Including legacy) R177	Essential	Highly intelligent multipurpose handsets and devices for converged networks Network support for 2.5 / 3G Terminals Terminals with routing decision options and technology in the base-band chipset	Mandatory in corresponding UEs	2010	
R178	*Preferred*	Over the Air software upgrade, faster-integrated silicon Modular, adaptable & renewable OS (Software defined terminals) Network support for legacy Terminals		2010	Device dependent
Bearers R179	Essential	An all Packet synch / non-synch services NGMN Multicast/Broadcast		2010	Device dependent

Functional criteria	Priority	BASIC FEATURES	UE impact	Ready at NGMN into?	Comments
R180	*Preferred*	All Packet PSTN/ISDN/CS emulation/simulation		NP	No position at this time